

13-001

**FY14 Application for Nursery Research Funding**  
**Washington State Department of Agriculture - Nursery License Surcharge**  
(Please use one application packet including the Progress Report page for each proposal.  
You must use our form - failure to do so may result in not funding your project.)

Project Title: IMPROVING FALL DEFOLIATION OF NURSERY APPLE TREES WITH BIOREGULATORS

Project Leader: DR DON C. ELFVING

Institution (if any): WA STATE UNIV., TREE FRUIT RES & EXT CTR

Mailing Address: 1100 N. WESTERN AVE, WENATCHEE, WA 98801

Email: delfving@wsu.edu

Project Phone Number: (509) 663-8181 x 252 Cellular/Pager Number: (509) 679-5607

Note: Project leader or his/her designee must be available at above project phone number on March 1, 2013 between the hours of 10:00-12:00 and 1:00-3:00.

Amount Requested for (FY13) July 1, 2013 to June 30, 2014: \$3,927

Start Date: 1 OCT 2013 Completion Date: 30 NOV 2013

(Check One) New Project ☐ Continuing ☒

If this is a multiple year project, please estimate and list the following information for each future July 1 - June 30 period listed below through project completion:

Fiscal Years (FY)	July 1, 2013 to June 30, 2014	July 1, 2014 to June 30, 2015	July 1, 2015 to June 30, 2016	July 1, 2017 to June 30, 2018	July 1, 2018 to June 30, 2019
\$ Amount Needed	3927				

If you are increasing the above amounts since your last application, please explain why:

\*Please list all other sources and amounts of funding for this project for the current year only: (Please notify us by March 1st if other funding has been approved and from where.)

Source	\$ Amount Applied For	Approved	Pending Date of Notification
NONE			

Total Amount Needed to Fund Project (Include all sources) \$ 3927

If total amount from all sources is not granted, will you be able to complete the project? N/O

Explain: MO ST OF THIS MONEY BUYS HELP. NO HELP = NO PROJECT

Submit 16 copies of this proposal to: Tom Wessels, Plant Services Program Manager, P.O. Box 42560, Olympia, WA 98504-2560, twessels@agr.wa.gov, or fax (360) 902-2094. All applications must be postmarked by December 31, 2011.

## WSDA LABORATORY SERVICES DIVISION - NURSERY RESEARCH APPLICATION

December 2012

**Project title:** Improving Fall Defoliation of Nursery Apple Trees with Bioregulators

**Investigator:** Don C. Elfving, Horticulturist and Professor

**Affiliation:** WSU Tree Fruit Research and Extension Center, Wenatchee, WA

### **Justification:**

Most apple-tree nurseries in Washington now defoliate their apple trees in the field in October or early November prior to digging the trees in November for storage during the winter in the warehouse under refrigerated conditions. This practice facilitates tree handling during the late-winter/spring tree shipping season, avoids potential delays in tree removal in late winter due to wet or frozen soils, and avoids the virtual certainty of cold injury in otherwise very vigorous trees with limited cold tolerance if they are left in the nursery over winter. Although many chemical products have shown promise for stimulation of leaf drop in past studies, apple-tree nurseries today rely almost exclusively on copper chelate or copper chelate + urea mixtures for stimulation of defoliation. The only alternative is hand defoliation, which is extremely costly.

Nurserymen face conflicting goals in the fall defoliation season. On the one hand, they would like to delay defoliation treatment as long as possible to allow their trees to achieve as much growth and accumulation of starch and nitrogen reserves through photosynthesis as possible before tree digging. On the other hand, defoliant applications must be initiated early enough in the fall to allow the trees to be dug and removed from the nursery before the soil freezes and/or significant low-temperature events threaten tree condition. Over the past several years, we have found that copper chelate/urea treatments typically require 4 or more weeks to achieve sufficient defoliation to permit tree digging without additional manual defoliation. In our trials over the past several years, we discovered that tank-mixes of two bioregulators, abscisic acid (ProTone, Valent USA) and cyclanilide (Tiberon, Bayer Environmental Science) produced much more rapid defoliation compared to either product alone or copper/urea combinations while producing no undesirable side effects on post-storage tree growth.

Unfortunately, in 2011 Bayer decided to terminate the production and sale of Tiberon. For that reason, exploratory research was initiated in fall, 2011 to assess whether abscisic acid (ABA), which alone can produce about 50% defoliation over a 4-week period, could be made more effective by some sort of combination treatment utilizing copper/urea. In two apple cultivars, application of ABA (1000 ppm a.i.) in late October, one week after a treatment with a tank-mix of copper EDTA plus urea (900 ppm Cu + 3 lbs./100 gallons urea), produced full defoliation after 3 weeks in 'Aztec Fuji' and 4 weeks in 'Jonaprince Jonagold' (difficult to defoliate), while the Cu chelate/urea combination alone only achieved 30-60% defoliation after 5 weeks.

This observation in 2011 that Cu chelate + urea accelerated the effectiveness of ABA was very interesting. It raised the question as to whether combining the Cu+urea directly with ABA as a tank-mix might improve the defoliation response even more. If effective, such an approach would also have the advantage of reducing the number of equipment passes through the nursery, thus saving additional material, labor and equipment costs as well as hand-thinning costs.

In follow-up research on this observation in 2012, we found that a tank-mix of ABA (1000 ppm a.i.) with copper EDTA plus urea (3 gallons CuEDTA/acre + 10 lb urea/acre) in a single application caused full defoliation in 'Aztec Fuji' trees within 2 weeks of treatment. This extremely rapid response raises several important questions about possible approaches to defoliation that might offer: 1) faster defoliation; 2) reduced concentrations of ABA and/or copper; 3) possible elimination of copper altogether; 4) delayed application to later in the fall to allow more time for normal leaf functions to take place; and 5) possible additional shortening of time to defoliation by introducing mechanical leaf-stripping to allow removal of partially loosened leaves following chemical treatments.

We have also observed that the Cu/urea plus ABA treatment appears to loosen leaves quite significantly at least one week before they actually fall off on their own. This observation suggests that even greater defoliation efficiency might be achieved if we combine the accelerated leaf-abscission effect of Cu/urea plus ABA with passing a mechanical leaf stripper through the nursery after only 1-2 weeks post-treatment. The mechanical leaf stripper is very effective for leaf removal as long as the foliar abscission layers have already become active but have not reached full separation. Based on 2012 observations, we believe that, by combining bioregulator treatment with leaf stripping, we may be able to accomplish commercial-scale defoliation as soon as 2 weeks after defoliant application, possibly with lower concentrations of bioregulator products as well. In addition, we may be able to significantly shorten the time to commercial defoliation with no more equipment passes than are presently used to achieve defoliation in 4-5 weeks after treatment.

### **Objectives of this research program in 2013:**

1. Examine whether reduced concentrations of ABA and/or copper chelate can produce commercially satisfactory defoliation using a single-application strategy when combined directly with urea in a tank-mix.
2. Investigate whether ABA can induce commercially satisfactory defoliation when mixed only with urea (i.e., eliminate the heavy-metal component).
3. Incorporate the mechanical leaf stripper as a component of a program to shorten the time from chemical treatment to commercial defoliation using lower chemical concentrations.
4. As needed, evaluate post-storage side effects, if any, on tree behavior.

### **Methods of research:**

Specific projects will be established in cooperating fruit tree nurseries. Trials will be laid out

according to randomized complete-block designs where possible with appropriately randomized treatment arrangements based on the specific treatments to be used. Plot size will be no less than approximately 400 feet and may be larger depending on the specific trial and the objectives for that trial. Data to be collected include percent defoliation at one-week intervals following spray treatment.

#### **Proposed schedule of accomplishments – 2013-2014:**

All work will be undertaken in the October-November, 2013 period just prior to tree digging. Trials will focus on:

- a. evaluation of the time course of defoliation following the various treatments;
- b. evaluation of how soon the leaf sweeper can be effectively used after defoliation treatment;
- c. record and evaluate any incidence of phytotoxicity or tissue damage prior to or after digging and storage.

#### **Anticipated benefits:**

Tree defoliation is now a standard part of the nursery tree production program in Washington. Optimizing this process for both efficacy and efficiency can help Washington fruit-tree nurseries produce high-quality trees at competitive prices.

#### **Literature review:**

A wide range of chemical products has been evaluated for potential as defoliators of apple nursery stock (e.g., Adisesh and Still, 1977; Erez, 1985; Larsen and Higgins, 1999). However, little has changed in terms of products used in at least a few decades (Knight, 1983; Larsen and Higgins, 1998). Chelated metals have been recognized as having leaf-removal potential for a long time (Knight, 1983; Larsen and Fritts, 1986). Absciscic acid, the last of the 5 major plant hormone groups to be widely studied, has become commercially available only in the last few years. Its potential as a chemical defoliant was reported years ago (Larsen and Higgins, 1998) but has yet to be carefully explored. The potential physiological benefit of being able to delay defoliation even for a few weeks in the fall is illustrated by work done a generation ago by Dr. Fenton Larsen and associates at WSU (Abusrewil et al., 1983). They reported a measurable increase in storage carbohydrates in trees defoliated 2 to 4 weeks later than others. The factors described above suggest that this area of research has considerable potential benefit for the nursery industry of Washington.

#### **Literature cited:**

- Abusrewil, G.S., F.E. Larson and R. Fritts, Jr. 1983. Prestorage and poststorage starch levels in chemically and hand-defoliated 'Delicious' apple nursery stock. J. Amer. Soc. Hort. Sci. 108:20-23.
- Adisesh, C.R. and S.M. Still. 1977. Defoliating nursery stock with combinations of ethephon,

endothall, and cycloheximide. HortScience 12:566-568.

Erez, A. 1985. Defoliation of deciduous fruit trees with magnesium chlorate and cyanamide. HortScience 20:452-453.

Knight, J.N. 1983. Chemical defoliation of nursery stock using chelated forms of copper and iron. J. Hort. Sci. 58:471-476.

Larsen, F.E. and R. Fritts, Jr. 1986. Chemical defoliation of tree fruit nursery stock with CuEDTA. HortScience 21:281-283.

Larsen, F.E. and S.S. Higgins. 1998. Absciscic acid as a potential deciduous fruit tree nursery stock defoliant. HortTechnology 8:47-51.

Larsen, F.E. and S.S. Higgins. 1999. Deciduous tree-fruit nursery-stock defoliation with combination sprays of Alanap, Depeg, and Ethrel. J. Tree Fruit Prod. 2:49-53.

**Budget:**

**Planned project duration 1 year**

**Current year request: \$3,927**

Year	Year 1 (2013-2014)
Total	3,927

**Current year breakdown:**

	Year 1 (2013-2014)
Salaries (Technical and Temporary) <sup>1</sup>	1,764
Benefits (77.3%) <sup>1</sup>	1,263
Supplies <sup>2</sup>	300
Travel <sup>3</sup>	600
<b>Total</b>	<b>3,927</b>

<sup>1</sup>Technical and time-slip help to set up trials, apply treatments and collect data as needed.

<sup>2</sup>This category includes a variety of miscellaneous supplies, non-capital equipment, consumables, etc. that are needed to carry out the research project.

<sup>3</sup>These funds will be used to defray costs of vehicle lease-to-purchase costs, operation and maintenance costs for travel to and from research plots in cooperator nurseries.

# Van Well Nursery

Helping Growers Grow

PETER J. VAN WELL  
RICHARD G. VAN WELL  
T. THOMAS VAN WELL  
JOSEPH R. VAN WELL

P.O. BOX 1339

WENATCHEE, WA 98807

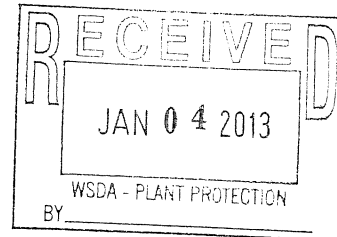
PHONE (509) 886-8189

FAX (509) 886-0294

E-mail: Vanwell@vanwell.net

January 2, 2013

Tom Wessels  
Dept of Ag, Plant Protection Div.  
PO Box 42560  
Olympia WA 42560



Dear Tom

I would like to recommend the approval of the "Nursery stock defoliation proposal" submitted to the Nursery license research fund by Dr. Don Elfving. He is working with one chemical that has shown very good results in defoliating nursery stock in the fall. This would save the industry many dollars over our present method of defoliation.

Sincerely

Pete Van Well  
General Manager  
Van Well Nursery Inc

## PROPAGATORS AND DISTRIBUTORS OF

GALE GALA\*  
GALA  
U.S. PLANT PATENT 10114

SCARLET SPUR\*  
RED DELICIOUS  
U.S. PLANT PATENT 4839

AUVIL EARLY  
FUJI  
U.S. PLANT PATENT 10141